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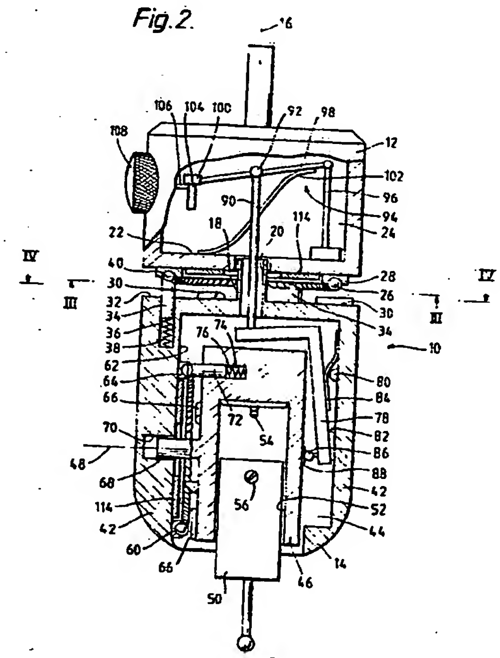
(54) **Probe head.**

(57) A manually operable probe head (10) has a support (12), by which the probe head may be attached to the head of a coordinate measuring machine, a first rotor (14) rotatable about an axis (16) relative to the support (12), and a second rotor (46) rotatable relative to the first rotor about a perpendicular axis (47). The first rotor (14) and second rotor (46) are each rotatable through a plurality of kinematic rest positions, into which they may be axially urged through retraction of a tie bar (90). Location of the first and second rotors when not in their rest positions is achieved by three spring loaded pistons (34) and (72). The pistons (34) and (72) ensure that even when not in their rest positions, the first and second rotors always come to rest adjacent such a position. The second rotor (46) carries a connector (54) for receiving a touch probe (50). The connector (54) is recessed within the probe head in a bore (52), behind the axis (47), and this provides a smaller reduction in the operating envelope of the machin (caused by the use of the probe head (10) in connecting the probe to the machine).

Fig.2.



and support.

Preferably the socket is mounted on the first rotor via a second rotor, mounted for rotation with the first rotor, and for rotation relative to the first rotor about a second axis, non-parallel to the first axis.

Preferably the probe head will be provided with means for determining the relative position of e.g., the first rotor and support, and displaying this on the body of the probe head.

An embodiment of the invention will now be described, by way of example, and with reference to the accompanying drawings in which:

Fig 1 is a perspective view of a probe head according to the present invention;

Fig 2 is a section on II-II in Fig 1;

Fig 3 is a section on III-III in Fig 2;

Fig 4 is a section on IV-IV in Fig 2; and

Fig 5 is a plan view of a part of the probe head in Figs 1 to 4.

Referring to Figs 1 to 4, a probe head has a cylindrical support 12 and a dome shaped rotor 14, mounted for rotation relative to the support 12. The probe head may be mounted to the quill of a coordinate measuring machine via the support 12. The rotor 14 is mounted for rotation relative to the support 12 about an axis 16 of a hollow shaft 18, which projects through an aperture 20 (defined by annular lip 22) in the base of the support 12, into a cavity 24 in the body of the support 12.

A ring of balls 26 (shown in Fig 3) is mounted on the base of the support 12 in an annular channel 28, concentrically with the aperture 20. The balls 26 are spaced about the circumference of a circle at $7\frac{1}{2}°$ intervals. Three seating members, in the form of radially extending cylindrical rollers 30 (also shown in plan view in Fig 4) are mounted in the upper planar surface 32 of the rotor 14, at points equally spaced about the axis 16. Thus, when the support 12 and rotor 14 are urged into contact with each other (by a mechanism which 'locks' the head 10, and which will be described subsequently), each of the rollers 30 seats in a cleft defined by the convergent surfaces of an adjacent pair of balls 26. The rotor 14 is thus kinematically supported with respect to the support 12. The ring of balls 26 provides forty eight such kinematic locations, and therefore forty eight discrete and repeatable orientations of the support 12 and rotor 14. Rotation of the rotor 14 relative to the support 12 (when the support 12 and rotor 14 are disengaged from each other), is provided for by the shaft 18 situated inside the aperture 20. The diameter of shaft 18 and apertur 20 should be chosen so that th apertur acts as a guide for the shaft wh n th rotor 14 is moving between kinematic locations, but should be large nough to enable the kinematic seating mechanism to dominate the relative position of the rotor 14 and support 12.

Three locating members in the form of pistons 34 are provided in the body of the rotor 14, spaced inbetween the rollers 30. The pistons 34 lie in bores 36, and are biased toward the support 12 by springs 38. The ends of the pistons 34 remote from the springs 38 have chisseled angular faces 40, which engage the convergent surfaces of adjacent pairs of balls 26. The springs 38 and pistons 34 act to bias the rotor 14 away from the support 12. Furthermore, the pistons 34, by virtue of their engagement with the convergent surfaces of an adjacent pair of balls 26, prevent unwanted rotation of the rotor 14 relative to the support 12 when the head is unlocked (i.e. the rollers 30 are disengaged with the balls 26). Rotation of the rotor 14 relative to the support 12 is achieved by ratcheting the pistons 34 around the ring of balls 26 (causing a slight axial displacement of the pistons 34). By virtue of their continual engagement with balls 26, the pistons 34 perform a third function. Namely, the pistons 34 ensure that upon completion of a rotation of the rotor 14 relative to the support 12, the rollers 30 always lie in register with the convergent surfaces of an adjacent pair of balls 26 rather than in between two such convergent surfaces. Any attempt to lock the (i.e. urge rotor 14 towards support 12 along axis 16) head when the rollers 30 lie adjacent a single ball, as opposed to the convergent surfaces of an adjacent pair of balls may result in damage to the head. This locating means provided by the pistons prevents the possibility of such damage.

The dome shaped rotor 14 has two halves 42 enclosing a central cavity 44. A cylindrical swivel 46 is mounted in the cavity 44 for rotation about its axis 48, which is perpendicular to the axis 16 of the shaft 18, and thus forms a second rotor. The swivel 46 houses a probe 50 in a bore 52, which extends diametrically in the body of the swivel 46. In the example shown, the bore is cylindrical but may have any cross-section to suit the probes to be housed. The probe 50 is connected to the swivel 46 via a connector 54. It can be seen from Fig 2 that the connector is recessed behind the axis 48 of the swivel 46 when the probe 50 faces downwards (i.e. its axis 51 is parallel to axis 16).

The connector 54 of this embodiment provides a mechanism for releasably mounting probe 40 to a kinematic support on the swivel 46 thereby obviating the need to re-datum a probe if the probes are changed. A rotatable catch 56 provided on the housing of probe 50 nables the locking and releasing of the probe from the connector 54 by engagement and disengagment of the probe 50 with spigot 55. The connector 54 and catch are well known per se and are disolosed, for xample, in WO85/02138. Because th connector 54 is re-

boards 114 are mounted concentrically with the annular channels 28 and 64 on the support 12 and rotor 14 respectively. A contact arm 116 (not shown in Figs 1 to 5 but illustrated in Fig 6) is mounted in register with each printed circuit board 114 on the upper surface 32 of the support and the exterior of the swivel 46, for rotation over the printed circuited boards 114. Each contact arm 116 carries three electrical contacts 118 to 122. The electrical contacts 118 and 120 are positioned for electrical connection with radially extending electrical contacts 110 on the printed circuit board 114; the electrical contact 122 is mounted for connection with common electrical contact. Contacts 118 and 120 are each at a positive voltage provided by a battery (not shown) and the contact arm 116 is connected to an incremental counting mechanism (not shown), which increments a count every time the circuit between contacts 118,120 and common contact 122 is completed and a pulse is emitted from the contact arm 116. The counting mechanism may provide on a display, an indication of the relative position of e.g. swivel 36 and rotor 14. The contacts 118 and 120 are offset from each other so that they form a circuit with the radial contacts 110, and common contact 122 at different angular positions of rotor 14 and swivel 46. By detecting which contact 118 and 120 comes into contact with the radial contacts 110 first during rotation of rotor 14 and swivel 46, an indication of both position and direction of movement of the motor 14 and swivel 46 can be obtained.

The circuit boards 114 should be orientated so that the electrical contacts 118 and 120 are not in contact with radial contacts 110 when the rotor 14 and swivel 46 are kinematically supported; this saves battery life.

The outputs of both such wiper mechanisms may be connected to a microprocessor which processes the incremental count and generates position and relative direction data on an LCD display so that the operator can determine instantly the orientation of the probe.

Instead of a wiper mechanism the pistons 34 and 72 may be used to provide an incremental count. In this alternative each downward movement of a piston as it passes over a ball (26 or 60) causes it to complete an electrical circuit and consequently emit an electrical pulse. To obtain directional information, one of the pistons would be slightly offset from the convergent surfaces of an adjacent pair of balls relative to the other two.

Claims

1. A probe head (10) for ori ntating a probe (50) r lative to a head of a coordinat positioning machine, comprising:
a support (12) for connecting the probe head to the head of the machine;
a first rotor (14) mounted to the support (12), and for rotation relative to the support (12) about a first axis (16);
a second rotor (46) mounted to the first rotor (14) for rotation with the first rotor (14) about the first axis (16), and for rotation relative to the first rotor about a second axis (47), the second axis (47) being substantially perpendicular to the first axis (16);
the second rotor (46) carrying a connector (54) for receiving a probe (50) the probe having an axis, characterised in that:
when the relative orientation of the first (14) and second (46) rotors is such that a said probe (50) has its axis parallel to the first axis (16), the distance between the connector (54) and the support (12) is smaller than the distance between the second axis (47) and the support (12).

2. A probe head (10) for orientating a probe (50) relative to a head of a coordinate positioning machine, comprising:
a support (12) for connecting the probe head (10) to the head of the machine;
a first rotor (14) mounted to the support (12), and for rotation relative to the support (12) about a first axis (16);
a second rotor (46) mounted to the first rotor (14) for rotation with the first rotor (14) about the first axis (16), and for rotation relative to the first rotor (14) about a second axis (47), the second axis (47) being non-parallel to the first axis (16);
characterised by:
the second rotor carrying a connector (54) for receiving a probe (50) the connector (54) being recessed within the probe head (10) in a bore (52), for housing the probe (50).

3. A probe head according to claim 1 wherein the connector (54) is recessed within the probe head in a bore (52) for housing the probe.

4. A probe head according to claim 2 wherein the first and second axes are perpendicular, and when the relative orientation of the first (14) and second (46) rotors is such that a probe when connected has its axis parallel to the first axis (16), the distance between the connector (54) and the support (12) is smaller than the distance between the second axis (47) and the support (12).

5. A probe head according to any one of the preceding claims wherein the probe head is manually operable, and the first (14) and second rotors (46) are mount d for seating in, and rotation between a plurality of repeatabl rest locations.

6. A probe head according to claim 5, further comprising means (78,90,108) for axially engaging the first and second rotors into their rest position,

Fig. 1.

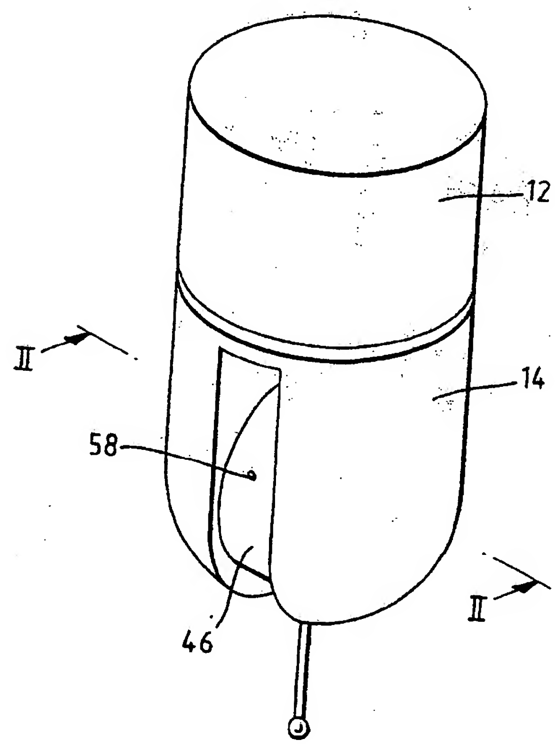


Fig. 5.

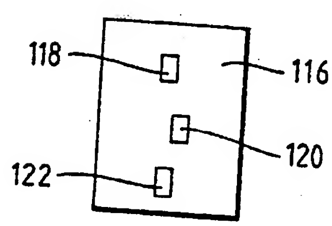


Fig. 3.

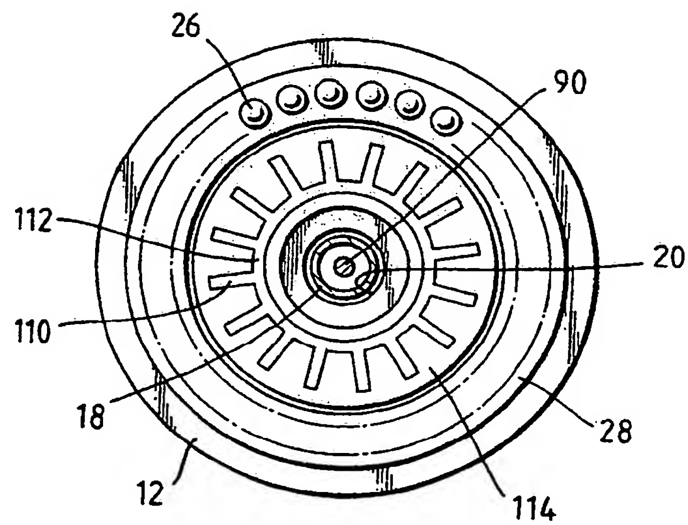


Fig. 4.

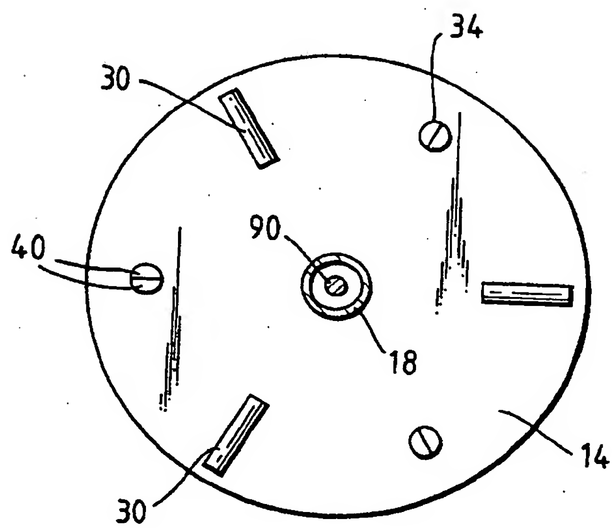


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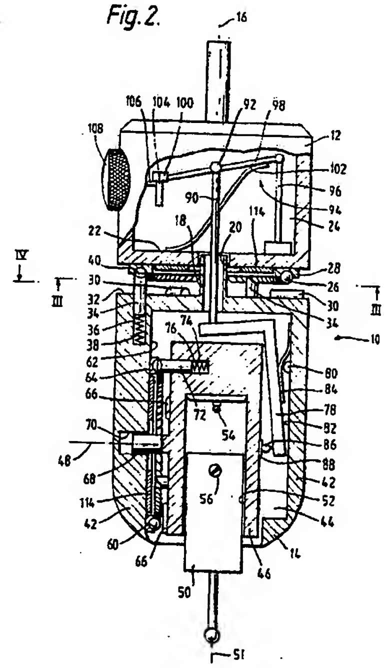
Fig. 2.



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